GB 2124752
FEB 1984

(12) UK Patent Application (19) GB (11) 2 124 752 A

(21) Application No **8311543**
(22) Date of filing **27 Apr 1983**
(30) Priority data
(31) **8212649**
(32) **30 Apr 1982**
(33) **United Kingdom (GB)**
(43) Application published **22 Feb 1984**
(51) **INT CL³**
F24F 7/00
B05C 15/00
F24F 9/00
(52) Domestic classification
F4V B1C B1D B1F B1G B1X2 B3D B4A B4B B4D B4E
U1S 1651 1663 1737 F4V
(56) Documents cited
None
(58) Field of search
F4V
F4X
B2L
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(54) Surface treatment plant

(57) A surface treatment plant e.g. a paint spray booth 1 comprises an enclosure 3 which has separate ventilated zones A,B defined by air curtains 11, one zone B being polluted differently than the others A. Each zone A, B, A has its own separator 13, 14, 13 for cleaning exiting air of its pollutant. In the illustrated embodiment, the outer zones A have dry separators 13 and the central zone B has a wet separator 14. Suitable conduits 17, 38 permit total or partial recirculation of the cleaned air, or total exhaust of the air to the atmosphere. Fresh outside air may be supplied to the ventilating flows along with spent ventilating air from the plant.

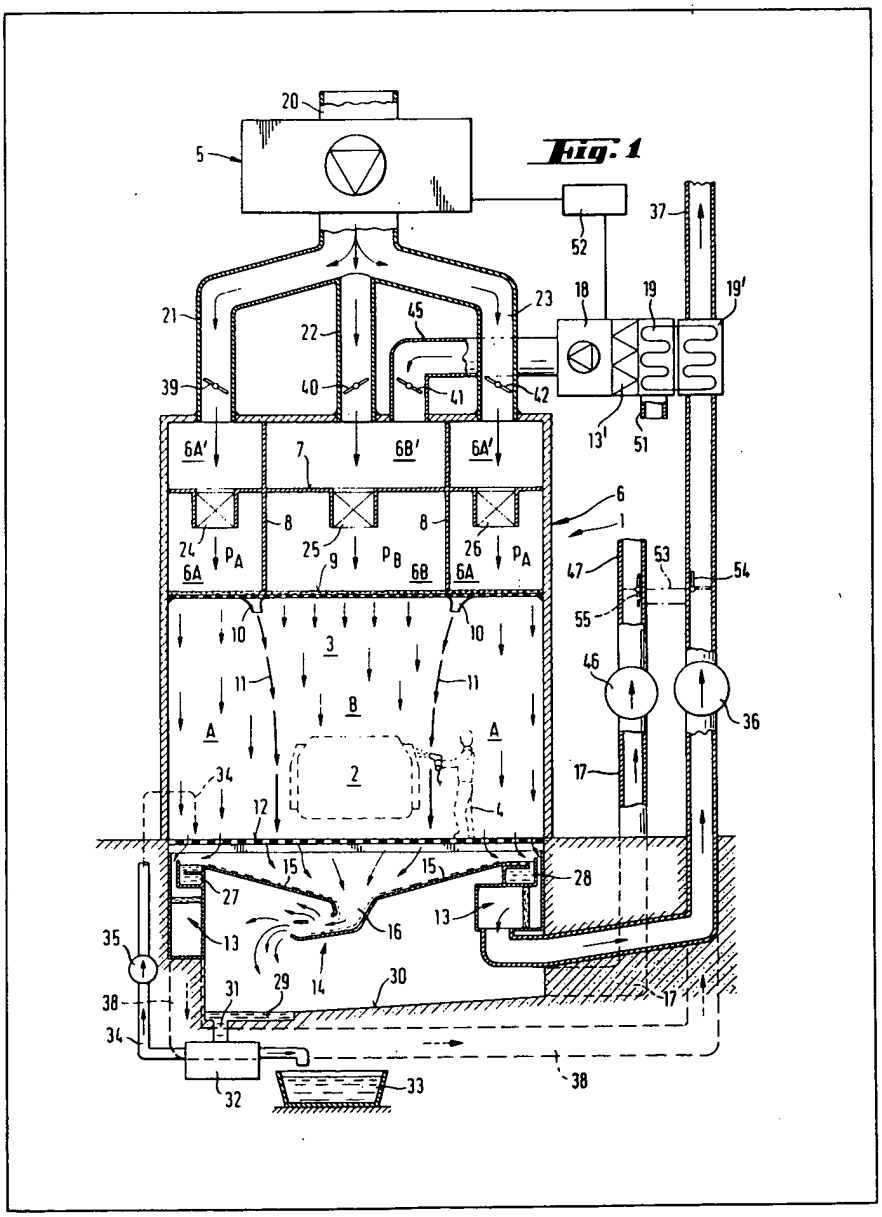

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Fig. 1

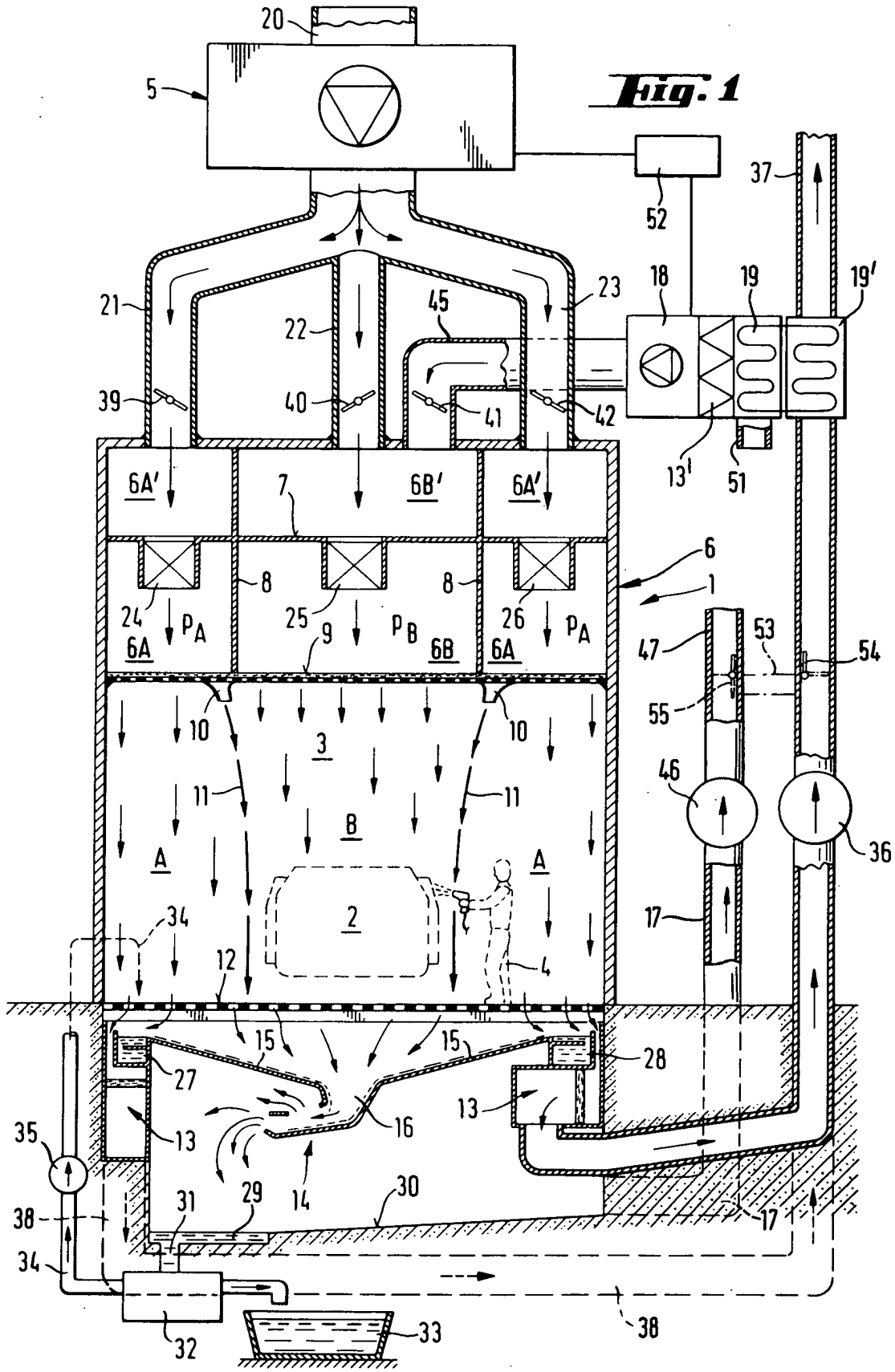

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Fig. 2

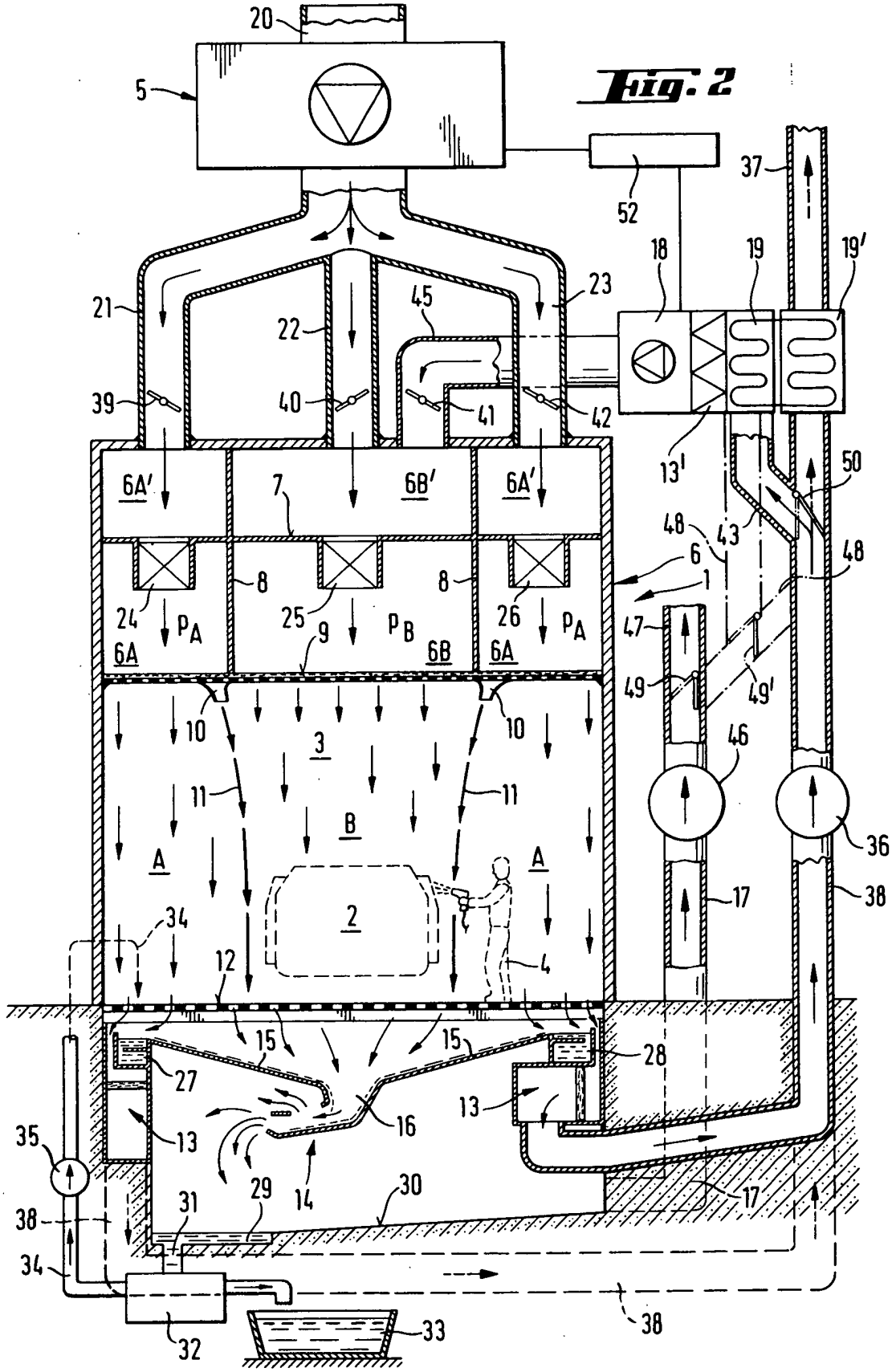

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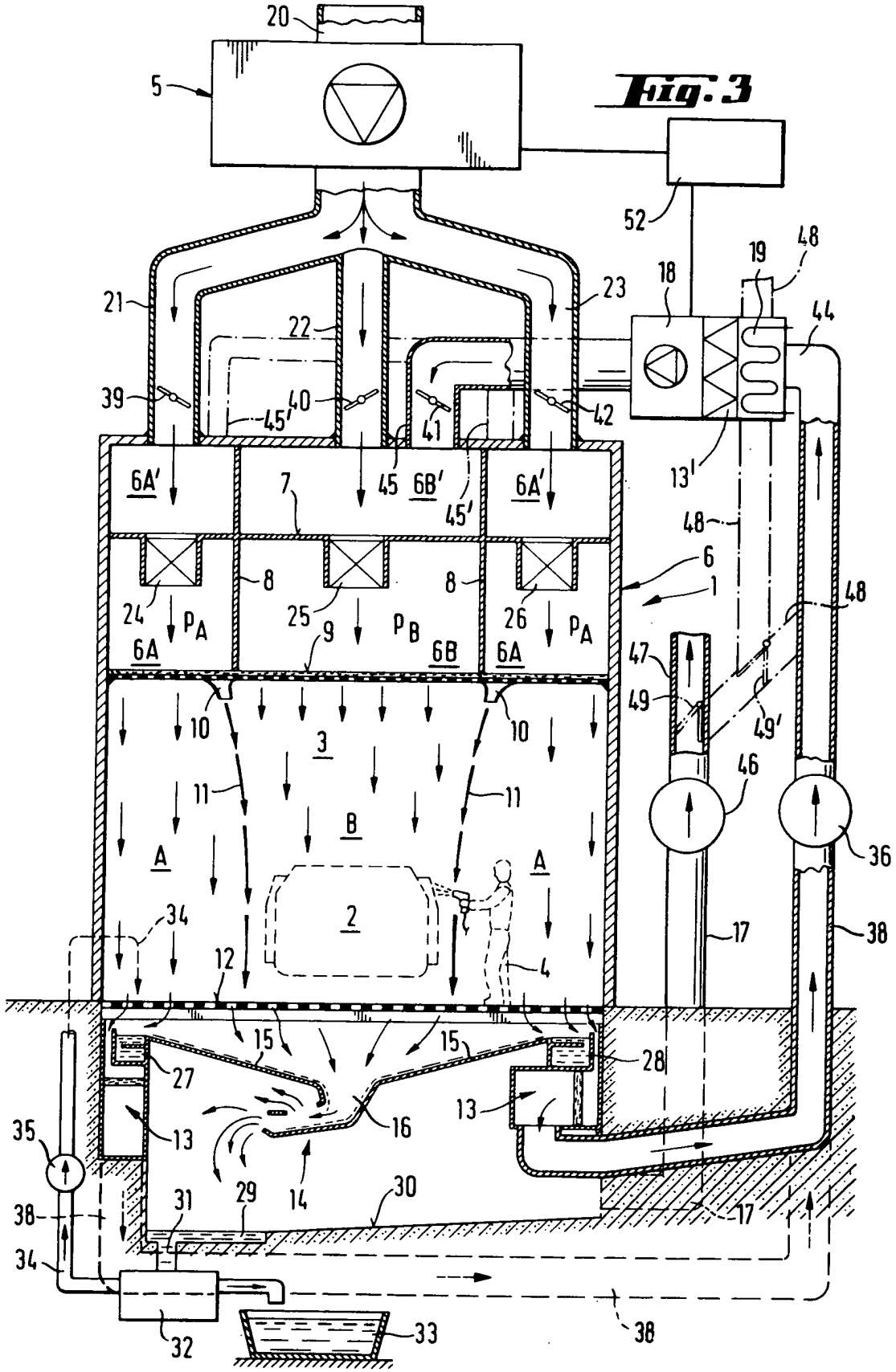
Fig. 3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SPECIFICATION

Surface treatment plant and a method of ventilating same

Technical field

The invention relates to a surface treatment plant and a method of ventilating such a surface treatment plant.

It is to be understood that in this specification the expression surface treatment plant means a plant in which an object or objects to be surface treated and/or coated are placed in or conveyed through an elongated enclosure, either continuously or intermittently, and are surface treated and/or coated within said enclosure. For example, the enclosure may include means for liquid painting by brushing or spraying, the application of other surface coatings by such means, other operations such as powder-coating, scuffing and grinding, and other pretreatments and after-treatments including heating and cooling of products.

Background art

Paint spray booths often form part of a production line for the manufacture of products such as car bodies. Fully assembled or partly completed car bodies are usually conveyed by a conveyor into a room or tunnel forming the enclosure part of the booth and a desired color or colors is or are applied by spraying paint onto the bodies either manually or automatically. In manual spraying suitably clad personnel or operators working in the booth direct paint spray equipment towards the bodies which are to be painted; gases and fumes as well as paint sprays and mists, are released during the spraying operation and these are injurious to health. An effective ventilation system both for the personnel and for the effective operation of the booth is thus required.

It is also often desirable to be able to apply different colors or shades to different products passing through a booth. Therefore cross-contamination of colors should be avoided by preventing paint drifting from one spray station to another within the booth.

Various booths have been devised in an attempt to provide a paint spray booth which avoids the health hazards and provides for a control of the spraying operations. In prior booths there is an air inlet in the ceiling through which inlet very large quantities of air are conducted into the booth. This air exits from the booth through an outlet arranged in the floor or elsewhere, and the mist, fumes, paint, dust and the like are swept out of the booth by the air and are expelled simultaneously with the air. If the air inlet quantity is insufficient, it often tends to cause undesirable turbulence, and randomly directed air streams are generated which carry mist, fumes, paint, dust etc. throughout the booth. To avoid turbulence, the air is passed into the booth with a relatively high velocity. It will, however, be understood that a booth for painting, for example, car bodies has a relatively large volume. Such a booth might for example be 20-60 meters long, 5-6 meters wide and 3-5 meters high. The ventilation air will be conveyed in that at normal ambient working temperatures e.g. in the range 19 to 23°C. For health reasons fresh external air is normally used for the ventilation, so that in winter air at very low temperatures, for example −20°C, has to be increased in temperature to a temperature condition. Therefore it will be understood that enormous amounts of energy are required to provide the necessary high volume of relatively high-velocity temperate air over the whole of the booth from ceiling to floor. Also from a practical aspect it is not possible to ventilate differentially different parts of prior booths to any significant degree without physically partitioning the booths.

Summary of invention

It is an object of the invention to seek to mitigate these disadvantages of the prior art.

According to one aspect of the invention there is provided a surface treatment plant having an enclosure as hereinbefore defined comprising means to supply ventilating air to the enclosure, means to provide at least one curtain of air to partition the enclosure into at least two zones extending over at least part of the enclosure within which zones the ventilating air passing through the enclosure entrains pollutant in the zones, the zones having different characters of pollution, for example one zone being more heavily polluted than the other zone, and separator means for each individual zone adapted to separate air and pollutant discharged from that zone.

According to a second aspect of the invention there is provided a method of ventilating a surface treatment plant as hereinbefore defined, comprising supplying ventilating air to the enclosure, providing at least one curtain of air to partition the enclosure into at least two zones extending over at least part of the enclosure within which zones the ventilating air passing through the enclosure entrains pollutant in the zones, and one zone being differently polluted than the other zone, and providing separator means for each individual zone and passing the air and pollutant from each zone to its respective separator means whereby air and pollutant from that zone are separated.

The separator means for air from the less heavily polluted zone may be a dry separator. This provides a simple yet efficient and inexpensive separator means.

The separator means for air from the more heavily polluted zone may be a wet separator. This provides an efficient means of separation.

The separator means for both zones may be adjacent the exit from the separate zones. This provides a compact structure in which the two separator means may be under a floor of the enclosure and permits cooperation between the two.

Alternatively or additionally, dry separator means may be provided adjacent the means to recirculate ventilating air into the enclosure.

The purified air exiting the respective separator means may be recirculated to the plant and/or passed through heat recovery apparatus, and/or

the wet separator wash water at least partially in a closed system, and thereby to reduce the discharge of contaminated water to the sewer system.

The dry separator 14 may consist of a single filter device in the entrances to the separator chamber 13 which removes pollutant material from the discharged air which exits through conduits 38. As shown, the dry separators are along opposite side edges of the wet separator and may handle contaminated ventilating air from zone B which is not exhausted through the venturi 16.

In a modification shown in Figure 3, the exhaust from the dry separators 13 may be recirculated to the plenum chambers 6A' and 6B' and a second dry separator 13' may be located adjacent the entry of the ventilating air to the booth. In such case, the separation in the dry separators 13 may be unnecessary and the filter units in the chambers 13 may be eliminated.

There are several possible ways to conserve the energy in the air exhausted from the paint spray booth in zones A and/or B and Figures 1-3 show some of the modes to achieve this. In the embodiment shown in Figure 1, the air from the wet separator 14 leaves through the conduit 17 by means of air exhaust means 46 and is normally evacuated to the surrounding atmosphere through a direct air outlet means 47. The air from the dry separators 13 is evacuated through air conduit means 38 with the aid of air exhaust means 36 and is discharged to the surrounding atmosphere by air outlet means 37. The air, before emerging from means 37, passes through a heat and/or moisture exchanger 19' transferring heat and/or moisture to the ventilating air fed into line 45. Cross-transfer conduit 53, air diversion flap valve 54 and 3-position flap valve 55 permit air from zone A and/or zone B to be selectively directed to either or both of the air outlet means 37 and 47.

Additional ventilating air for the paint spray booth 2 is provided by an additional supply means 18, preferably with dry separator meand 13' and conditioning means 19, i.e. means for heating and/or cooling of the air, possibly as part of or coupled with the heat and/or moisture exchanger 19'. Such a unit is provided with air inlet means 51, which is connected to a suitable air source, for instance spent ventilation air leaving the building housing the paint spray booth, or the atmosphere in general. The use of spent ventilation air from the building reduces the need for substantial energy input to condition the recirculated air to the proper working and comfort levels within the enclosure 3.

In order to provide the paint spray booth 1 with a suitable mixture of fresh and recirculated air at the right temperature and moisture content, there is provided a regulating means 52 to control and adjust the fresh air supply means 5 and/or the recirculated air supply means 18. This regulating means may be operated automatically as well as by a hand-operated control means, such as a control panel in an operator's room. This regulating means 52 in Figure 1 usually comprises more than one operating system and can be made to influence all the control means in the air supply system, such as flow control valves 39, 40, 41, and 42, distributor inlets 24, 25 and 26, air supply means 5 and 18, air exhaust means 36 and 46, and cross-transfer flap valves 54 and 55.

Figure 2 shows alternative modes which may be combined to recirculate air to the paint spray booth 1. The air outlet means 37 has a branch return air inlet 43 to the air recirculation system, and an air diversion flap valve 50, which can be positioned to either recirculate the air or discharge it to the atmosphere through the heat and/or moisture exchange means 19'. The Figure also shows that it is possible to provide the air outlet means 47 with a branch air conduit 48, which merges with the branched return air inlet below the branch 43 or is directly connected to the conditioning means 19 or the dry separator 13' or the supply means 18 or separately to the heat and/or moisture exchange means 19'. The air conduit 48 is provided an air diversion flap valve 49 at its junction with the conduit 47, which can divert the air to any one of the units in the air recirculation system or to the atmosphere. The branched air conduit 48 may be forked with an air diversion flap valve 49' and the other means 19 or 13' or 18. All the valves 49, 49', and 50 may, of course, be positioned in any intermediate position, thus diverting only part of the air flow to the air recirculating system and means 19'.

Figure 3 shows an air recirculation system, where all the air leaving zones A is directed to the air recirculation system by a return air inlet 44 positioned above the blower 36 in place of the outlet 37. From the air outlet means 47 connected to the wet separator 14, i.e. zone B, there may be a branch air conduit 48, which is connected to the air recirculation system inlet 44 and has air diversion flap valve(s) 49 and/or 49' to control the air flow as discussed in connection with Figure 2. In Figure 3, it is shown, that air is returned to the central part 6B' by means of return air conduit 45 and control valve 41. However, return air inlets 45' also return air to the side parts 6A'. The precondition for the latter is, of course, that the recirculated air does not contain any harmful ingredients such as excessive amounts of solvents.

The embodiments of the invention shown in Figures 2 and 3 provide very favorable opportunities to adapt the recirculation of air to the prevailing environment conditions. During the cold season it is expedient to return air from the dry separator with room temperature to the paint booth through the recirculation system. During warm periods it is more favorable to recirculate the air from the wet separator, because this air is cooled close to the dew point, when passing the wet separator. In addition to the control of the conditions of the recirculated air by choosing a suitable air stream from the wet and/or dry separator, the air is further conditioned in the conditioning means 19 for recirculated air, as well as in the separator means 13' and supply means 18, including such conditions as temperature, moisture, speed, pressure, and purity.

It will be understood that the air curtains 11 may be generated by providing suitable openings or inlets in the filter ceiling 9. However, the nozzles 10 are preferred because they may be moved or altered in position, so adjusting the position of the curtains,

said supplied ventilating air is partly fresh air and partly recirculated air.

23. A surface treatment plant having an enclosure in which said surface treatment is effected substantially as hereinbefore described with reference to and as shown in Figures 1, 2 and 3 of the accompanying drawings.

24. A method of ventilating a surface treatment plant having an enclosure in which said treatment is effected, substantially as hereinbefore described with reference to and as shown in Figures 1, 2 and 3 of the accompanying drawings.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1984.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.